Notes:
1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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## CLAIM + DETAILED DESCRIPTION

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[Claim(s)]

[Claim 1]Composite grains which mix metal powder and crystalline carbon materials and are obtained a pressurization miniaturization and by making it decode.

[Claim 2]The composite grain according to claim 1 whose mixed rate of metal powder and crystalline carbon materials is one to crystalline carbon-materials 200 weight section to metal powder 100 weight section.

[Claim 3]The composite grains according to claim 1 or 2 which are one kind chosen from powder of an alloy in which metal powder contains metal chosen from powder or said group of metal chosen from a group which consists of Fe, Cu, aluminum, Ag, Be, Mg, W, nickel, Mo, Si, and Zn, or two kinds or more.

[Claim 4]The composite grains according to any one of claims 1 to 3 which are one kind as which crystalline carbon materials were chosen from graphite, carbon fiber, carbon black, fulleren, or a carbon nanotube, or two kinds or more.

[Claim 5]High-heat-conductivity composite obtained by carrying out hot pressing of the composite grain according to any one of claims 1 to 4.

[Claim 6]High-heat-conductivity composite which has the organization which metal powder whose mean particle diameter is 5 micrometers - 1 nm distributed to a crystalline carbon matrix.

[Claim 7]The high-heat-conductivity composite according to claim 6 obtained by carrying out hot pressing of the composite grain according to any one of claims 1 to 4.

[Claim 8]A manufacturing method of composite grains which mix metal powder and crystalline carbon materials and pressurization miniaturization - Make decode.

[Claim 9]A manufacturing method of the composite grain according to claim 8 whose mixed rate of metal powder and crystalline carbon materials is one to crystalline carbon-materials 200 weight section to metal powder 100 weight section.

[Claim 10]A manufacturing method of the composite grains according to claim 8 or 9 which are one kind chosen from powder of an alloy in which metal powder contains metal chosen from powder or said group of metal chosen from a group which consists of Fe, Cu, aluminum, Ag, Be, Mg, W, nickel, Mo, Si, and Zn, or two kinds or more.

[Claim 11]A manufacturing method of the composite grains according to any one of claims 8 to 10 which are one kind as which crystalline carbon materials were chosen from graphite, carbon fiber, carbon black, fulleren, or a carbon nanotube, or two kinds or more.

[Claim 12]A manufacturing method of the composite grain according to any one of claims 8 to 11 which perform a pressurization miniaturization and composite-ization with metal powder and crystalline carbon materials with a ball mill.
[Claim 13]A manufacturing method of the composite grain according to any one of claims 8 to 12 which perform a pressurization miniaturization and composite-ization with metal powder and crystalline carbon materials at low temperature 40 ** or less among an inert gas atmosphere.
[Claim 14]A manufacturing method of high-heat-conductivity composite which carries out hot pressing of the composite grain according to any one of claims 1 to 4.
[Claim 15]A manufacturing method of the high-heat-conductivity composite according to claim 14 which performs hot pressing at 20-1500 ** among an inert atmosphere.

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[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to high-heat-conductivity composite and its manufacturing method. This invention relates to a composite grain suitable as a charge of manufacture material of high-heat-conductivity composite, and its manufacturing method. The high-heat-conductivity composite of this invention is useful as a construction material in which the high heat conductivity of thermal machinery, such as a heat dispersion board for electric circuit protection, a heat exchanger, and heat pump, is demanded.
[0002]
[Description of the Prior Art]Conventionally, as the thermal machinery accompanied by the phenomenon of heat exchange and heat transfer, or general-purpose heat-conduction material for heat dispersions, cast iron, stainless steel, copper and a copper alloy, an aluminium and an aluminium alloy, nickel and a nickel alloy, titanium and the titanium alloy, the zirconium alloy, etc. are mainly used. Copper, an aluminium, etc. with the highest heat conductivity are used for thermal machinery, such as a heat exchanger as which high heat conductivity is required especially, over the temperature span from ordinary temperature to high temperature.
[0003]However, in modern society, while the requests to the art of energy saving are mounting increasingly, the thermal machinery which has higher heat conductivity or thermal efficiency is called for, and it is necessary to develop the general-purpose heat-conduction material which has higher heat conductivity compared with copper, an aluminium, etc. In the thermal machinery which makes metal, such as copper and an aluminium, heat-conduction material, there is a problem also in points, such as the wettability of a medium and metal, and acidity or the corrosiveness of the metal by an alkaline medium.
[0004]
[Problem to be solved by the invention]In thermal machinery, such as a heat sink for electric circuit protection, a heat exchanger, and heat pump, [ the purpose of this invention ] It is in providing the high-heat-conductivity material which has high heat conductivity, and is in providing the new high-heat-conductivity material which has still higher hydrophilicity and corrosion resistance so that it can become alternate material currently used conventionally, such as copper and an aluminium.
[0005]
[Means for solving problem]When this invention persons make various metal decode by a specific method

wholeheartedly in view of the aforementioned purpose with crystalline carbon materials, such as graphite whose heat conductivity is higher than copper, and carbon fiber, as a result of examination, It found out that the composite of the carbon and metal which have more than twice as high heat conductivity as the copper currently generally used for thermal machinery is obtained, and that the composite which made the crystalline carbon matrix distribute metal powder minutely especially had high heat conductivity.
[0006]this invention -- metal powder (for example, Fe, Cu, aluminum, Ag, Be, and Mg.) One kind or two kinds or more, and the crystalline carbon materials who were chosen from the powder of the alloy containing the metal chosen from the powder or said group of the metal chosen from the group which consists of W, nickel, Mo, Si, and Zn. (For example, one kind or two kinds or more which were chosen from graphite, carbon fiber, carbon black, fulleren, or a carbon nanotube). (at mixed rate [ For example, receiving metal powder 100 weight section. ] of one to crystalline carbon-materials 200 weight section) It mixes and is related with the composite grain obtained and its manufacturing method a pressurization miniaturization and by making it decode.
[0007]This invention relates to the high-heat-conductivity composite obtained by carrying out hot pressing of the composite grain concerned, and its manufacturing method. This invention relates to the high-heat-conductivity composite which has the organization which the metal powder whose number average particle diameter is 5 micrometers - 1 nm distributed to the crystalline (for example, obtained by carrying out hot pressing of said composite grain) carbon matrix.
[0008]In a new field as which performances, such as corrosiveness and hydrophilicity, are required, it not only can use high-heat-conductivity composite of this invention as alternative material for thermal machinery which is using conventional copper, an aluminium, etc., but it can demonstrate the characteristics.
[0009]
[Mode for carrying out the invention]
As composite grain metal powder, powder of an alloy containing one or more kinds of metal simple substances or these metal, such as Fe, Cu, aluminum, Ag, Be, Mg, W, nickel, Mo, Si, and Zn, can be used. The metal powder can use one kind for independent or two kinds or more, mixing it. Composite with higher heat conductivity can be obtained by using powder, such as metal powder with high heat conductivity, for example, Cu, Ag, aluminum, and Be.
[0010]As crystalline carbon materials, natural graphite, artificial synthetic graphite, carbon fiber, fulleren, a carbon nanotube, and carbon materials that have other crystallinity can be used. Crystalline carbon materials can use it as powder or a staple fiber. Crystalline carbon can use one kind for independent or two kinds or more, mixing it. Composite with higher heat conductivity can be obtained by using good crystalline carbon materials, for example, natural graphite, artificial synthetic graphite, etc.
[0011]receiving metal powder 100 weight section in a material composition, although there is no limitation in particular about the mixed rate of metal powder and crystalline carbon materials -- crystalline carbon materials -- the composite with easy shaping whose heat conductivity is high can be obtained by considering it as ten to 100 weight section preferably one to 200 weight section. In a desirable embodiment, composite grains are the after alloy powder of the carbon/metal in which metal powder and crystalline carbon materials were pressurized and compounded, and the mean particle diameter of the metal powder in a carbon matrix is 5 micrometers - 1 nm.
[0012]The pressurization miniaturization and composite-ization of a mixed material with metal powder and crystalline carbon materials can be carried out what is called by carrying out mechanical alloying treatment.

Mechanical alloying treatment can be carried out mixing and by grinding using a ball mill. According to a desirable embodiment, the pressurization miniaturization and composite-ization of a mixed material are performed so that the mean particle diameter of the metallic particle in the carbon matrix of the composite grains obtained may be set to 5 micrometers - 1 nm.
[0013]It is preferred to carry out the pressurization miniaturization and composite-ization of a mixed material in an inert gas atmosphere, and it is preferably preferred to carry out at low temperature 0 ** or less preferably especially 30 ** or less 40 ** or less. [ by carrying out the pressurization miniaturization and composite-ization of a mixed material at low temperature 30 ** or less among an inert gas atmosphere ] In a carbon matrix, a metallic particle can manufacture the uniformly dispersed composite efficiently, and especially it among an inert gas atmosphere, [ low temperature 0 ** or less ] For example, among argon gas atmosphere, by carrying out cooling by liquid nitrogen, it is convenient in order to be able to manufacture much more detailed composite grains and to manufacture high-heat-conductivity composite.
[0014]If carry out adequate amount combination, metal powder and crystalline carbon materials are made intermingled and these powder mixtures are pressurized, detailed mixing will advance and the homogeneity of each grain will increase, and functionality is added to character which each grain has, and alloy grains which have higher performance and functionality, i.e., composite grains, generate. If a high energy ball mill etc. are used and especially pressurization is carried out by what is called mechanical alloying treatment, It is processed, it becomes flat [-like ] and a new field is exposed, and these new fields are forge-welded, it comes to unite, this is repeated, a miniaturization and homogenization advance further according to collision / compression impulse force, and composite grains which have the fine structure of below micron nm order generate each grain.
[0015]High-heat-conductivity composite can be manufactured by carrying out fabrication of the high-heat-conductivity composite composite grains. High-heat-conductivity composite which has especially the characteristics which were excellent hot pressing, i.e., by carrying out heat pressure molding, in composite grains of this invention can be manufactured. Hot pressing of composite grains can be carried out at 20-1500 ** among an inert atmosphere.
[0016]In a process in which high-heat-conductivity composite is obtained by carrying out hot pressing of the composite grains, The more it is important to perform hot pressing in an inert gas atmosphere and under a suitable temperature and compacting pressure is high, more precise composite can be manufactured and, the more characteristics, such as heat conductivity and machinery hardness, can obtain good high-heat-conductivity composite. For example, high-heat-conductivity composite which has one 2.3 times the heat conductivity of a copper plate can be manufactured by fabricating the copper / graphite alloy powder manufactured from copper powder and natural graphite powder at 800 ** by a pressure of 10000 kg/cm$^2$ among argon atmosphere.
[0017]
[Working example]The work example and comparative example of this invention are shown below, and the place by which it is characterized [ of this invention ] is clarified further. [0018]Natural graphite (shape of powder, 99% of purity) 10 weight section is blended with work-example 1 copper powder (particle diameter [ of 100 micrometers ], 99.8% of purity) 90 weight section, and it mixes. These powder mixtures and the stainless steel ball of 100 weight sections were taught to the stainless steel container with a content volume of 200 ml, and what is called mechanical alloying treatment was performed for 12 hours, cooling by liquid nitrogen among

an argon gas air current by a vibration ball mill. Where air is intercepted by the pressure of 800 ** and 10000 $kg/cm^2$, hot pressing of the obtained alloy grains was carried out to disc-like. The heat conductivity according the obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0019]Natural graphite (shape of powder, 99% of purity) 30 weight section is blended with work-example 2 copper powder (particle diameter [ of 100 micrometers ], 99.8% of purity) 70 weight section, and it mixes. These powder mixtures and the stainless steel ball of 100 weight sections were taught to the stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as the work example 1. The heat conductivity according the obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0020]Natural graphite (shape of powder, 99% of purity) 50 weight section is blended with work-example 3 copper powder (particle diameter [ of 100 micrometers ], 99.8% of purity) 50 weight section, and it mixes. These powder mixtures and the stainless steel ball of 100 weight sections were taught to the stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as the work example 1. The heat conductivity according the obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0021]Natural graphite (shape of powder, 99% of purity) 30 weight section is blended with work-example 4 aluminum-dust (particle diameter [ of 200 micrometers ], 99.9% of purity) 70 weight section, and it mixes. These powder mixtures and the stainless steel ball of 100 weight sections were taught to the stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as the work example 1. The heat conductivity according the obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0022]Natural graphite (shape of powder, 99% of purity) 30 weight section is blended with 70 ****** in the end (the particle diameter 20 - 60mesh, 99.9% of purity) of work-example 5 iron powder, and it mixes. These powder mixtures and the stainless steel ball of 100 weight sections were taught to the stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as the work example 1. The heat conductivity according the obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0023]Artificial graphite (what [ was manufactured from a petroleum coke ], shape of powder, 99% of purity) 30 weight section is blended with work-example 6 nickel powder (Type287, 99.0% of purity) 70 weight section, and it mixes. These powder mixtures and a stainless steel ball of 100 weight sections were taught to a stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as a work example 1. Heat conductivity according an obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0024]Copper powder (particle diameter of 100 micrometers, 99.8% of purity) of comparative example 1100 weight section and a stainless steel ball of 100 weight sections are taught to a stainless steel container with a content volume of 200 ml, What is called mechanical alloying treatment was performed for 12 hours, cooling by liquid nitrogen among an argon gas air current with an oscillating pole mill. Where air is intercepted by a pressure of 800 ** and 10000 $kg/cm^2$, hot-press molding of the obtained alloy grains was carried out disc-like. Heat conductivity according an obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0025]Aluminum dust (particle diameter of 200 micrometers, 99.9% of purity) of comparative example 2100 weight section and a stainless steel ball of a 100 weight county were taught to a stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as the comparative example 1. Where air is intercepted by a pressure of 800 ** and 10000 kg/cm$^2$, hot-press molding of the obtained alloy grains was carried out disc-like. Heat conductivity according an obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0026]The stainless steel ball of the iron powder end of comparative example 3100 weight section (the particle diameter 20 - 60meSh, 99.9% of purity) and 100 ****** was taught to the stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as the comparative example 1. Where air is intercepted by the pressure of 800 ** and 10000 kg/cm$^2$, hot-press molding of the obtained alloy grains was carried out disc-like. The heat conductivity according the obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0027]The nickel powder (Type287, 99.0% of purity) of comparative example 4100 weight section and the stainless steel ball of 100 weight sections were taught to the stainless steel container with a content volume of 200 ml, and mechanical alloying treatment was performed on the same conditions as the comparative example 1. Where air is intercepted by the pressure of 800 ** and 10000 kg/cm$^2$, hot-press molding of the obtained alloy grains was carried out disc-like. The heat conductivity according the obtained disc-like sample to a laser flash method at a room temperature was measured. The result is shown in Table 1.

[0028]

[Table 1]

表 1

| 実施例 | 組　　成 | 熱伝導率(W/m°K) |
|---|---|---|
| 実施例1 | 天然黒鉛／銅＝１０／９０ | ５２６ |
| 実施例2 | 天然黒鉛／銅＝３０／７０ | ７９９ |
| 実施例3 | 天然黒鉛／銅＝５０／５０ | ９６３ |
| 実施例4 | 天然黒鉛／アルミニウム＝３０／７０ | ４９３ |
| 実施例5 | 天然黒鉛／鉄＝３０／７０ | １４９ |
| 実施例6 | 人造黒鉛／ニッケル＝３０／７０ | １７３ |
| 比較例1 | 銅＝１００％ | ３９１ |
| 比較例2 | アルミニウム＝１００％ | ２３５ |
| 比較例3 | 鉄＝１００％ | ７８．５ |
| 比較例4 | ニッケル＝１００％ | ８８．６ |

[0029]

[Effect of the Invention]According to this invention, heat conductivity composite as high than mere metal as more than twice is obtained. The high-heat-conductivity composite of this invention is excellent also in characteristics, such as corrosion resistance, hydrophilicity, and machinery hardness. Since the high-heat-conductivity composite of this invention has high heat conductivity and can moreover process various shape, it

is useful as a construction material in which the high heat conductivity of thermal machinery, such as a heat dispersion board for electric circuit protection, a heat exchanger, and heat pump, is demanded.

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[Translation done.]